

Extraction of gold using cyanide

Cyanide has been used in New Zealand in gold extraction since the end of the nineteenth century. It has made the extraction of gold from gold ore much more effective and therefore more economic.

Cyanide does occur naturally. It is secreted by hundreds of species of bacteria, algae, fungi, plants and insects.

The problem with using cyanide in gold extraction is that cyanide is toxic to plant and animal life. It is toxic as it causes asphyxiation. In New Zealand there has been a case of a young girl who ingested a number of apricot kernels, after the season had ended. The girl developed signs of acute poisoning. Apricot kernels from the same batch were tested for cyanide levels and contained 0.33% levels of cyanide.

Therefore it is important not to let the cyanide after it has been used to get into the waterways. The companies that extract gold therefore need to put systems in place that prevent this happening or keep the levels of cyanide entering the environment acceptable according to New Zealand standards.

Cyanide consists of nitrogen and carbon joined together by a triple bond. It has a formula CN^- . Another type of cyanide that is poisonous is hydrogen cyanide which has formula HCN . It is the cyanide ion that is used in gold extraction.

The process:

The ore is ground and crushed to make a slurry. To collect the gold from the ore it needs to be separated from the other minerals in the ore. To do this the gold needs to be made into a soluble form so that it can be separated from the other minerals as gold is insoluble. **To make gold soluble sodium cyanide (NaCN) is added and the cyanide ion forms a complex ion with the gold. This complex ion, $[\text{Au}(\text{CN})_2]^-$, is readily soluble.**

The dissolved gold in the form of the complex now needs to be separated out and recovered. This can be done by either absorption onto activated carbon or by zinc cementation. In absorption the dissolved gold forms on the carbon and in zinc cementation zinc powder and electricity is used. It is then further refined until the final product is obtained.

The slurry, known as tailings is what is left after the gold has been recovered. This slurry contains cyanide and it is this that must be dealt with so that the cyanide does not enter the environment.

At one of the mines near Waihi they have used what is known as the Cyanisorb process. Rather than trying to destroy or dispose of the cyanide it is recycled so that it can be used again in gold extraction. The slurry has sulphuric acid added to it. This converts the cyanide ion to be converted to hydrogen cyanide. This is then made into hydrogen cyanide as. This does not require high temperatures as hydrogen cyanide is volatile. Air is mixed in to help this process. Sodium hydroxide is added to reabsorb the sodium cyanide, which can now be reused for leaching the gold. After this some natural processes could occur to dispose of any leftover cyanide in the tailings.

At this mine they have found that this is more economic and it reduces the amount of sodium cyanide that needs to be transported to the mine in the form of solid briquettes.